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CONTENTS

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THE VALUE AND SERVICE OF ZOOLOGICAL SCIENCE[1]

SPIRITUAL VALUES

THE material values of science are often heralded, while its spiritual values pass unnoticed. Leaving all tangible values unemphasized, we shall here contend that the intangible values of science in general and of zoology in particular are the more significant. These we may characterize as "spiritual," using the term over against "material" and without further implication. Thus, if we speak of man's spiritual yearnings in contrast with his material needs, we may not have a clear idea of what this phrase implies, but we recognize in this contrast the existence of something the opposite of material. That which constitutes "the spirit of the man" is too illusive for definition, yet it is a thing we recognize as existent and in such a sense the word spiritual is used.

In the present world crisis there are none who decry the material values of science. Our very national existence depends upon them. But there are many who raise the question whether science on its spiritual side is not a failure, whether the war is not science gone mad; and we scientists need to consider what is the source of this undercurrent of criticism which sets against the freedom of science. In the eyes of the man in the street, science represents only material accomplishment and even among the educated such a belief is not uncommon. We men of science do not believe this. Why should others? Perhaps we are to blame

[1] Symposium before the American Society of Zoologists, Minneapolis, December 29, 1917.

for not having taken the public sufficiently into our confidence. If it is our belief that science has emancipated the spirit of man by freeing it from ignorance and superstition, and in so doing has brought advantages in excess of the material comforts which are the more obvious fruits of scientific progress, it is time we laid more emphasis upon these intangible values. For by these we live and work, rather than by the desires of a sordid materialism.

1. Material Comfort and Spiritual Progress

Betterment of his material surroundings reaches beyond man's physical comfort; for such betterment enables him to fix his attention upon "that which is not bread." We reach the heights now and then from the flood of difficulties which surrounds us; and there may be all the more satisfaction in this, when we do so in spite of adverse conditions, when we will not be wholly fettered by mere circumstance. Yet for sustained achievement in nation or individual there must be relief from an oppressive struggle for existence. What H. G. Wells[2] has termed "this misery of boots" must be overcome before we can realize our spiritual desires. Those who have lived as the favored members of society may prate of their superiority over material things; but one suspects that a sojourn in a New York tenement or a Pittsburgh slum would convince any one of us that he owes much of what he has accomplished to the stability of his material foundations, and to the absence of acute pressure in matters of food and shelter. Some of us call ourselves poor, comparatively speaking; but we have frequent relief from toil and much of our toil has always been self-imposed. On the other hand, conditions that are too easy are not conducive to spiritual progress; for we are not yet far enough removed from the state of nature, under which we took origin, to react favorably in the absence of stimulation. The proposal to fill men's stomachs as a stimulus to their morals is worth considering, even though history and experience show that the hardest thing for man or nation to thrive upon is material prosperity. A fair degree of prosperity is indispensable, though excess may prove disastrous.

Now one of the things science has done is to establish our prosperity. In civilized lands, we can be sure of enough for the entire population to eat and of enough to wear. The problem is no longer how to produce the necessities of life so much as how to distribute them. In matters of production we are far ahead of our power to effect a just distribution. The socialists are right in their contention, that if we would deal fairly in distribution no man would be obliged to work more than four or five hours a day and that each could devote the remaining time to his spiritual interests, that under such a system many of our social problems would disappear. Our first claim for science, as having spiritual value, is, therefore, its establishment of the material foundations upon which spiritual advancement rests. While this value should not be minimized, since it lies at the basis of civilized life, it is easy to cite other values not so immediately allied to things material.

2. Science and Imagination

We often hear it said that, since science has destroyed the mystery of the universe, nothing remains for imagination. This statement has, I think, no basis in fact, and

[2] Wells, H. G., "This Misery of Boots," Ball Publishing Co., Boston, 1908.

arises from the failure to appreciate what science has done. Instead of restricting our imagination science has so enlarged our horizon that we may take a bolder flight. To the mind of primitive man and to the savage who survives in this state until our own times, nature appeared a thing of caprice rather than of order. The world was one of spirits, good or evil, who must always be considered, with whom man must make his peace. The day as well as the night was peopled with beings who ruled in the absence of any definite sequence of events and safety could be found only by submission to their caprice or propitiation of it. Under these conditions imagination had full play. But who in our generation would choose this brand of imagination? When man first observed the changeless motion of the stars "without haste, without rest," and gained an inkling that the same orderly sequence might apply to all natural phenomena, the opportunity for imagination was not lost. It was placed on a higher plane. The inhabitants of Europe, who once imagined Hell or the "Islands of the Blest" to lie beyond the Atlantic, have lost many fields in which the imagination of medieval man found exercise; but what a vista has been opened. Consider the sweep of the evolutionary conception through time and space. Or consider man as the victor over nature, notwithstanding those laws which are inexorable for other living things. No other species is known to have spread itself so widely over the earth and to have so changed its environment to suit its needs. Herein lies the difference between man and the rest of the animal world. Wherever else an animal has been subjected to a new environment, the result has been death or the evolution of a new type suited to meet the changed conditions. But man has taken himself and his domesticated plants and animals into surroundings to which neither he nor they are properly adapted; and instead of paying the penalty inevitable in a state of nature, has survived and the creatures under his care have survived with him. Where nature would say "Die!" man has said, "I will live!"; and he has succeeded in this because he forces from his environment the readjustments necessary for his well-being. Not always is this possible. The path is not trod with ease, but it is being steadily pursued. In his essay entitled "Nature's Insurgent Son," Lankester[3] thus compares man to an insurgent gone so far in his rebellion that there is no return; for capitulation can mean only death. The rebel must continue on his course until the end is won, if he is to find safety. He can not now return to the dominion of nature, he must succeed by controlling his surroundings, and knowledge of how to do this is more vital to him than aught else.

Again, take the poetry in modern invention. For it is there in plenty when you know how to find it, as Kipling has done time and again, but nowhere better than in his verses on "The Deep-sea Cables."

The wrecks dissolve above us; their dust drops down from afar—
Down to the dark, to the utter dark, where the blind white sea-snakes are.
There is no sound, no echo of sound, in the deserts of the deep,
Or the great gray level plains of ooze where the shell-burred cables creep.
Here in the womb of the world—here on the tie-ribs of earth
Words, and the words of men, flicker and flutter and beat—
Warning, sorrow and gain, salutation and mirth—
For a Power troubles the Still that has neither voice nor feet.
They have wakened the timeless Things; they have killed their father Time;

[3] Lankester, E. R., "The Kingdom of Man," Holt and Co., 1907.

Joining hands in the gloom, a league from the last of the sun.
Hush! Men talk to-day o'er the waste of the ultimate slime,
And a new Word runs between: whispering, "Let us be one!"

Is there not food for imagination in the phenomenon of the wireless message? A few years ago I spent a summer at the Puget Sound Marine Station. On a hill behind us was a wireless establishment to which we sometimes tramped for a chat with the operators. One day we were told with pride they had just picked up a communication from Key West, the longest distance from which that station had ever received a message. We below the hill had known nothing of this. "Warning, sorrow and gain, salutation and mirth" had passed over our heads on the wings of the air, and the telling of their passage was a revelation of things in the universe of which man knoweth naught, but which are not unknowable. To my mind we have gained more with the advance of science than we have lost; and imagination need not go unfed, when out of the fog, the night and the distance, as though from another world, comes that which signals "Save our Ship," to listening ears a thousand miles away on sea and shore.

3. Science and Esthetic Appreciation

Esthetic appreciation may seem as distant from science as are the poles from one another. Yet if we analyze the case, our esthetic response becomes, when stripped of what is non-essential, an intellectual rather than a sensual pleasure. The "good, the beautiful and the true," as we see it, is largely that to which we are accustomed, whether it be a brand of perfume, a style in skirts or a scientific theory. Also its cost, as Professor Veblin[4] shows, is an influential factor. Personally, I hold to the faith that there are such things as the beautiful and the ugly, that it is not all a matter of that to which one is accustomed, only I often doubt whether any of us know what's what. Within the purely intellectual realm, however, we are on safer since more common ground. For example, the satisfaction one has in the demonstrated theorem or in the chain of evidence when the last link is forged, is an esthetic satisfaction. There is the same feeling of completeness as in beholding the creation of artist or sculptor from which nothing could be taken away or nothing added without marring its perfection. Say that we appreciate such things merely because our minds run in certain channels. The fact remains that our minds so run, and that as long as human minds continue to be what they are we may expect them to follow similar courses. Stories are told of great minds completing their scientific discoveries in a state bordering on religious exhaltation, but many of us have felt the same thrill even though the work were not our own. The writer remembers how when a student he was taken by the "Mosquito-malaria Theory," as it was then called; and at a later date the esthetic appreciation with which he contemplated the apparent explanation of Mendelian segregation and of the determination of sex in terms of the behavior of chromosomes. In spite of uncertainties and the need for further investigation, one felt himself gazing at a picture near enough completion to show what it might become—a sequence so wonderfully ordered as to call forth an esthetic fervor. To many of us, therefore, scientific thinking and the contemplation of the theories of science present an esthetic appeal of the first order.

[4] Veblin, T., "The Theory of the Leisure Class," Macmillan Co., 1912.

4. SCIENCE AND FAIR JUDGMENT

A further aspect of science, having spiritual value, is the habit of fairmindedness induced by scientific reasoning. If scientific thinking is but a way of looking at things, the essential element of which is the formation of impersonal judgments—the reasoning in a way to reduce the personal equation to a minimum; if in this respect alone does the knowledge of science differ from that of everyday life, science may perform an important service by helping us to impersonal judgments in other lines.

To illustrate concretely, a teacher of theological students, desirous of imparting information regarding the origin of man, might find an effective approach through geology. There is little to arouse prejudice in the study of weathering, erosion, deposition and glaciation. When, however, these lessons have been learned, with their inevitable inference regarding the lapse of time, one finds an easy passage to the problems of organic evolution and thence to the question of man's origin. The same methods of reasoning are used throughout; only, in the last case, there is much to excite prejudice and this prejudice might be aroused by attacking the problem of man without preliminaries. So great is the similarity in the scientific method, wherever used, that the viewpoint obtained in an impersonal subject like geography, astronomy, or geology can be taken over bodily to allied fields. And the interpretation of phenomena remote from personal interest induces a dispassionateness which is a good point of departure for a journey into debatable territory.

The whole theory of evolution may be cited in further illustration. If this be presented as an interpretation of the facts of nature, to be accepted or rejected on the same basis as one would the earth's sphericity or the Copernican theory of the solar system, it is easy to show that the cases are parallel, when viewed impersonally and as scientific problems. Once into the subject, one passes insensibly to the problems of society, which are at bottom evolutionary problems. Poverty and crime, eugenics and euthenics, the organization of the state, and the rights of the individual are debatable in no such simple terms as comparative anatomy and embryology, paleontology or ecology; and because of this are subjects for prejudiced controversy rather than open-minded discussion. Take the case of poverty. How can a man with the scientific temper regard this as a question to be decided wholly in terms of the convenience or profit of landlord or employer of labor? The biologist might be influenced by his preconceptions of heredity and environment, but in so far as he shut his eyes to the evidence and failed to consider all the factors involved, he would be false to his scientific spirit.

Human beings suffer much from emotionalism in public matters. We shall doubtless continue to be guided by our hearts rather than our heads, but it is to be hoped we may come to use better judgment. In public affairs, it is particularly important that we think things out. At the beginning of all clear thinking in these matters are the facts of science, and the method of science is needed at every turn. If the question is upon religious revivals of the old-fashioned sort, we need to know, with such degree of scientific accuracy as is possible, the history of these movements in the past, and their psychological aspects in the present, before we can determine relative values. Now that democracy is spreading, we need, as never before, to correlate facts and weigh evidence in the dispassionate manner which is the ideal of

science. It is of little value to love truth and justice, if our ignorance makes it impossible for us to understand what is truth or how to do justice in a given instance. Truth may be relative and justice approximate, but we could do a far better job of it by making intelligent use of the facts we have.

Many of us believe that science has done more to help the cause of truth and justice in society than has any other line of human endeavor; for science has taught man the sequence of events to which he must conform if the individual or the nation is to reach its highest development. Because of scientific teaching, men demand to-day reasons for conduct other than traditional prohibitions or indulgences. And these reasons must be based upon scientific facts and presented in terms of scientific method. Science furnishes the groundwork to which our ethical judgment must conform. The old, emotional forms of thought play a losing game. Sentimentality is losing its grip in favor of a calm, farsighted determination to know what is true that we may do what is right, which is the highest ethical ideal. Science does not furnish the incentive to truth and justice, but it does furnish the material out of which truth and justice may be constructed by use of the scientific method; and for the individual, it furnishes the data needed for a well-ordered life.

If you can keep your head when all about you
Are losing theirs and blaming it on you;
If you can trust yourself when all men doubt you,
But make allowance for their doubting too:

Here again, Kipling states our case; for he presents the ideal of striving for truth and justice, not blindly but with a view to the whole situation.

We contend that the scientific method furnishes the only safe approach in our attack upon the complex problems of human life; since it enables us to approach these problems in a saner fashion, making for dispassionate judgment and for the elimination of prejudice. Now this elimination of what influences the "you" and the "me," in favor of what can be agreed upon as a fair interpretation by us all, is no easy matter. Scientific men do not always live up to their ideals within their own domain nor do they always carry over their ideals to daily life. But this impersonal way of thinking is a priceless possession, and if scientific men strive to apply it in life generally the effort is worth while however short it falls. We need more facts of science for our material progress, but more than this we need the method of science for the penetration of sham and for the elimination of personal interest in our dealings. The plea is not that the scientist is always a good citizen, but that the scientific method is useful for the citizen; that, as social life becomes more complex, it is necessary for the citizen to apply this method as a tool wherewith to shape the conclusions which shall guide his conduct.

5. SCIENCE AND EMANCIPATION

Finally, the value of science inclusive of every other is its influence upon our mental outlook; for only by the acquisition of a scientific habit of mind do we find intellectual emancipation. In substantiation of such a claim, we may cite the theory of organic evolution, which is the most comprehensive illustration afforded by the biological sciences, and perhaps by science generally.

The evolutionary concepts current among the Greeks were tinctured with philosophy. Lacking concreteness, they made little headway; and we find the beginnings of modern evolutionary doctrine in the accumulation of facts regarding animals and

plants which marked the centuries just preceding the year 1750. To Buffon and to other less known writers of the eighteenth century belongs the credit for having first promulgated the evolutionary theory in a form which was scientific rather than philosophical and which carried a measure of conviction, despite its crudities and the hampering of theological criticism. One can not turn the pages of Buffon's encyclopedic work without a growing respect for the knowledge of animal life there represented. Obviously, the foundation for much of our comparative anatomy of vertebrates was even then established. It is a familiar story how Lamarck was the first to offer a theory of the causes of evolution; how he failed to make his case as against the authority of Cuvier; how the latter, although opposing evolution, accumulated some of our strongest evidence, through his studies in comparative anatomy; and how von Baer supplemented this by his work in embryology; until in Darwin's day there were ample facts at hand for the establishment of the fact of evolution, if not for the determination of its causation.

As Professor Lovejoy[5] has pointed out, evolution itself aside from its causes might have been accepted, as the only reasonable interpretation of the facts, at any time after the year 1840. That it was not so accepted among those who ridiculed the "Vestiges of Creation," is a sad comment upon the open-mindedness of science and the psychology of conviction in its relation to evidence. The story that science hesitated for lack of evidence, only adduced by the "Origin of Species," does not represent the facts. Though we have inherited this tradition from so clear a thinker as Huxley, we should be anxious to replace it with a frank avowal, that the two decades following 1840 present a humiliating spectacle to workers who pride themselves upon the acceptance of doctrines whenever and wherever the evidence is forthcoming. The fact is that during the period in question science may well be accused of shutting its eyes to patent evidence. Darwin's claim to distinction lies in his early recognition of the evolutionary problem as at the core of biological science, and in his marshalling of facts for evolution and for his theory of "Natural Selection" in a manner that was overwhelming. The almost immediate acceptance, in biological science, of Darwin's views and the spread of the evolutionary concept to other fields during the remaining years of the nineteenth century are well known. Evolution has won its fight. We are here concerned with its effects upon human thinking in the past and its probable influences in the future.

The triumph of the evolutionary conception completed the overthrow of those older ideas of the universe which culminated in medieval theology. Evolution was the final extension of that enlarging horizon disclosed by the theory of the earth's sphericity and the Copernican theory of the solar system, concepts which are indissolubly united and which represent each a stride forward in the face of diminishing resistance. It went hard with Galileo, and so would it have gone with Copernicus had all the implications of his theory been recognized before his death. Buffon was not in physical danger, though forced to recant. Darwin, though heaped with abuse, suffered not even inconvenience at the hands of his critics. During the three centuries involved, man's picture of himself

[5] Lovejoy, A. O., "The Argument for Organic Evolution before 'The Origin of Species,'" *Popular Science Monthly*, November and December, 1909.

changed from that of a being, recently created and awaiting a day of judgment in the not distant future, to that of a being originating as part of organic nature and set in a universe without beginning and without end. The by-product of this intellectual revolution was an emancipation of the human spirit from the bonds of authority. Authority indeed remained, but no longer that of book or pope. In its place came the authority of nature; and so great was the change we have not yet recognized its full significance.

While we can the better visualize the effects of evolutionary doctrine by thus going back several centuries, it is equally important to recognize what is happening to-day, how this doctrine has affected theological belief since the year 1859, what has happened in philosophy, and what changes have occurred in our outlook upon the problems of society.

In theology, the evolutionary doctrine is carrying us from the concept of a single religion, revealed to man by agents duly inspired, to a multitude of religions of varying worthiness, but all the outgrowth of yearnings which originated with human intelligence. We need not condone the shortcomings of the fathers nor strive for theological explanations of sin and death, of sorrow and pain since these are the not unnatural incidents of our evolution. We know in part whence we came, if not whither we are going, and it is enough if we may by our own efforts somewhat improve the material and spiritual state of ourselves and our children. This new viewpoint has been reached not by a sudden break with the past, but by a gradual shift of mental attitude which makes the older doctrines impossible of acceptance. We have applied the evolutionary concept to religion, as to every other expression of organic nature; and the result has been a revolution, accomplished before its beginnings were recognized. Thus science has brought emancipation from theological bondage and set free the spirit of man for higher flights in the future.

In philosophy, the evolutionary theory has necessitated the change from a static to a dynamic universe, as witness the contrast between the philosophical systems of the early nineteenth century and the views of Bergson. This change has not yet completed its remodeling of philosophical theories, but only a philosopher can explain its workings.

In the field of social phenomena, we see the influence of the evolutionary theory through the recurrent questioning of the necessity for existing conditions. If the revolutions of the eighteenth century attacked the foundations of civic power and sought to install the authority of peoples over that of kings, the revolution induced by the evolutionary theory has shaken the whole edifice of social tradition. Whatever *is* may be the natural outcome of the evolution of society to date, but it is not thereby right nor is it necessarily permanent. We may, as evolutionists, recognize the stability of social customs, which have arisen by evolution; but we also recognize these customs as subject to change. Moreover, we must consider the intelligent direction of our future evolution as a possibility, however remote. Evolution has not always taken the most desirable course, as witness the degeneration incident to parasitism; and while we shall probably have little to do with its outcome in the human species, what we may do is worth considering. Germany has evolved a social organization threatening the ideals which dominate the majority of western nations, in challenging which we are striving to direct

the course of social evolution. If we succeed, individualism working collectively will triumph over medieval collectivism.

The influence of the evolutionary conception may be seen again in our attitude toward social problems such as disease and crime. These are not inevitable conditions to be treated by curative measures only. They are to be attacked with all the knowledge of hereditary and environmental factors we can command, and finally eliminated by the evolution of a type of man and a form of society in which such excrescences will be non-existent. We are no longer content with our lot, merely because things have been as they are within the memory of man or because we see no prospect of immediate change. Things have changed in the past and we want to change them in the future. We are not content to let evolution take its course with us, we want to make it go our way. Thus the insight into social changes which evolution brought has given a habit of mind that will brook no restriction upon the human spirit. As with philosophy, we have the change incident to an outlook upon a dynamic as opposed to a static world.

In conclusion, we have shown that science feeds the spiritual as well as the material man. Science deals with what we can measure and weigh, is wholly impersonal, is a thing of the intellect rather than of the emotions. But the intellect and the emotions are not separate entities of the mind, rather the mind is a unit which has its intellectual and its emotional sides. The raw material of scientific fact is susceptible of unlimited organization within the mind and this process of organization gives play to our spiritual nature. If we have made our point, the progress of science has given the spirit of man far more than it has taken away.

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MEASURES FOR PROTECTING WHEAT-FLOUR SUBSTITUTES FROM INSECTS

Readers of Science may be interested in work being done to prevent the loss of wheat-flour substitutes due to insect attack. Many of the millers and dealers who handle the cereals which the Food Administration is now requiring as substitutes for wheat flour have always recognized them as being subject to insect attack to such a degree that it has been considered poor policy to handle them extensively during the summer months.

The amount of embryo which is included in a flour, and the coarseness of the product are usually taken as an index of susceptibility to insect attack, coarse flours with the most embryo being the most susceptible. The wheat-flour substitutes and other cereals contain embryo, are relatively coarse, and are known to be highly susceptible to insect attack.

Millers, dealers and consumers, will handle more of the susceptible cereals than usual this summer and, unless unusual care is taken to protect them, the requirement of the Food Administration may result in an increased loss of food and thus defeat the object of the government. However, such losses can be prevented and, if proper precautions are taken, the handling of wheat-flour substitutes need not lead to serious complications with insect pests. The division of entomology and economic zoology in cooperation with the department of animal biology at the University of Minnesota, and the Minnesota State Food Administration have been outlining recommendations and methods for aiding the millers, dealers and consumers of Minnesota in preventing losses of wheat-flour substitutes. The measures are preventive and it is proposed to cover the state with propaganda before any serious trouble has arisen.

The millers are probably the best prepared for the new conditions. The operators of the large flour mills in Minneapolis have learned from experience that these cereals must be carefully handled and they were the first to anticipate complications arising from the war-time emergency. The cereals which are put upon the market in sacks are not permitted to remain in storage but are hastened to the con-

sumer, if possible, in less time than is required for the development of the insects beyond the egg stage.

The cereals which go out in sealed packages are heated to about 85° C. at the time of packing. This temperature will kill all stages of insects and if the packages are tightly sealed such products are practically free from insects' attack, unless they are stored in badly infested places. When the insects have access to packages, they will enter through any cracks which they may find and in cases of bad infestation they will make holes through the wrappers and boxes. To protect themselves against losses while these cereals are in the possession of retail dealers, many of the large milling concerns are turning the cereals over to the dealers with only a "sound on delivery" agreement.

It is with the retail dealers and the consumers that this work is particularly concerned. With the millers protecting themselves by rapid transit and the "sound on delivery" agreement the liability of loss devolves upon the retail dealers and the consumers. The retail dealers and consumers must protect themselves against the introduction of undeveloped insects in the cereals. In many of the retail stores where proper precautions are not taken the insects are present and ready to infest the sacked cereal and even that in sealed packages may be destroyed or infested with eggs. Cereals not destroyed in the store may contain eggs which either did not hatch during the short period after leaving the mill or were deposited while in the infested store. The result is that the homes are very apt to become infested. Dealers are recommended to adopt the miller's policy of rapid handling of cereals and to take proper precautions in the sanitation of their stores. Instructions are being sent out to the dealers emphasizing the responsibility resting on those who handle wheat-flour substitutes and warning them of the serious losses which may result if they permit the cereals to be exposed to insect attack.

Consumers are instructed to buy small quantities of cereal, to avoid "sealed package" cereals when the packages are broken or contain holes, to heat "sacked cereals" just as soon as they are taken home, and to use great care in storing all wheat-flour substitutes. If the millers and dealers are able to eliminate their loss by the rapid handling of cereals the loss which our country will experience will depend upon what the consumer does to eliminate loss after the cereal reaches him.

The heating of the cereal to kill any stages of insects which it may contain will protect the consumer against the infestation of the home and in addition it will reduce to the minimum the loss caused by cereal insects. A method of heating cereals in the oven has been simplified and standardized as a result of a series of experiments on heat conduction in cereals and fatal temperatures of the insects infesting them.

The problem in heating is to obtain a condition in which the minimum temperature in any part of the cereal is well above the fatal temperature of the insects, about 45° C. at 24 per cent. of relative humidity. At the same time the temperature in the hottest part must be kept well below the heat which will injure the cereal. about 94° C. This can be done by placing the cereal in pans about two inches deep and heating it in the oven until the surface of the cereal reaches 85° C. At this point the fire should be turned out, in the case of gas, gasolene, or kerosene ovens, and the cereal should be left in the closed oven for forty-five minutes. If a coal or wood stove is used, the oven door should be opened when the top of the cereal reaches 85° C. and the fire should be kept low during the forty-five minutes. Temperature curves representing the temperature of the top, center and bottom of such a pan of cereal show that the center of the cereal reaches a temperature between 55° and 60° C. and that it remains above the fatal temperature for insects for about half an hour.

Since thermometers which indicate high temperatures are not in reach of all housewives, a wax has been standardized to melt between 82° and 85° C. and is to be manufactured under the direction of the Food Ad-

ministration. The wax is furnished in small pieces packed in boxes which will cost the consumer five cents for a season's supply and is to be distributed to the retail dealers through the jobbers. The directions are very simple and explicit, for one has only to place some wax upon a piece of paper on top of the cereal and heat until the piece of wax melts to a grease spot which will be 85° C. Then it is recommended that the cereal be mixed and left in the oven for forty-five minutes as stated above.

Warnings with regard to the proper storage of the cereal after it has been heated make it clear that the cereal will remain free from insects only when stored where no insects can get at it.

The cereals used in the heating experiments have been submitted to various cooking processes by the department of domestic science at the University of Minnesota and no injury was apparent even when the cereals were heated to a temperature of 95° C.

This work has been undertaken in anticipation of a condition which seems very certain to develop. With the cooperation of the millers in "sterilizing" and rapidly handling the cereals, of the dealers in increased sanitation and in furnishing consumers with "heat-testing wax," and finally of the consumer in heating the cereal when it reaches him, it is hoped that our country may be aided in its effort to conserve the food needed to win this war. Similar campaigns in other states might aid in reducing a loss which seems inevitable if no unusual measures are taken.

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SCIENTIFIC EVENTS

THE PROGRESS OF BIRTH AND DEATH REGISTRATION IN THE UNITED STATES

THE recent inclusion of Hawaii has extended beyond the limits of Continental United States the area for which the Census Bureau annually collects and publishes death statistics. Within this area now reside about 73 per cent. of the total population of Continental United States and Hawaii. It comprises, in all, 27 states, 43 cities in other states, the District of Columbia and the territory of Hawaii. East of the Mississippi the only states not included are Alabama, Delaware, Florida, Georgia, Illinois, Mississippi and West Virginia, while west of the Mississippi the only states included are California, Colorado, Kansas, Minnesota, Missouri, Montana, Utah and Washington.

The annual collection of death statistics from states and cities maintaining adequate registration systems was begun by the Census Bureau in 1902, the first report covering the calendar years 1900 to 1904, inclusive, and for each succeeding year a separate report has been published. The original registration area contained 40 per cent. of the total population of the country. It remained unchanged until 1906, since which year it has shown an almost uninterrupted increase in geographical extent and in proportion of total population, until at present it contains nearly three fourths of the country's inhabitants.

In birth registration highly satisfactory progress has been made during the past two years, although there are still a number of states in which adequate death registration prevails but in which the registration of births has not yet reached a sufficiently close approximation to completeness to justify the acceptance of the local records by the Census Bureau. The birth-registration area, as at present constituted, comprises 19 states—the six New England states, New York, Pennsylvania, Maryland, Virginia, North Carolina, Kentucky, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Utah and Washington—and the District of Columbia. This area is estimated to contain about 51 per cent. of the total population of the country, as against about 31 per cent. when the collection of birth statistics was begun, a little more than two years ago, from an area comprising the six New England states, New York, Pennsylvania, Michigan, Minnesota and the District of Columbia.

This growth, in so short a time, is gratifying. It is, however, unfortunate that in the United States the registration of vital phe-

nomena has thus far depended, first, upon adequate state or municipal legislation, and, second, upon the adequate enforcement of that legislation. As a result, some states and municipalities maintain efficient registration systems while others do not. Until the matter is placed under federal control or supervision it is not likely that reliable birth and death records, approximating completeness, will come into existence throughout the entire United States. Since the military registration of June 5, 1917, the desirability of maintaining such records has become apparent to all.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE

Sir Henry E. Armstrong, chairman of the executive committee of the International Council of the Central Bureau of the International Catalogue, writes in *Nature:*

The Conjoint Board of Scientific Societies, some time last year, appointed—by what mandate is not clear—an International Catalogue Subcommittee "to obtain information regarding the extent of the use made by scientific men of the present International Catalogue of Scientific Literature, and to obtain recommendations for possible improvement." The subcommittee consisted of Dr. Chalmers Mitchell, Mr. C. V. Boys and Mr. E. B. Knobel, in addition to the official members. The subcommittee appears to have gone outside the terms of reference and to have reported "that it was advisable to consider suggestions for an alternative scheme." . . .

The history of the International Catalogue is briefly as follows. In 1893 the Royal Society was memorialized to take into consideration the preparation of complete author and subject catalogues, by international cooperation, in continuation of the society's Catalogue of Scientific Papers, which the society did not propose to continue beyond the century. The proposal being viewed with favor, the Royal Society solicited the opinion of scientific workers all over the world. There was practically but one reply—that such catalogues were essential, and almost universal agreement that the only way of carrying the work into execution was by international cooperation. Representative committees were appointed, and after two years of very hard work a scheme was prepared which was forwarded abroad, together with the invitation to attend the first international conference on the subject. This was held in July, 1896. Two subsequent international conferences were held in London in October, 1898, and June, 1900. All three were highly representative. Ultimately it was decided, at the third conference, to establish the catalogue as an international enterprise. Work was begun in 1901, and has been continued up to the present time. The organization has grown steadily in weight and efficiency, and at the beginning of the war there were thirty-four regional bureaus in operation. The harmony which has prevailed throughout among the nations is one of the most remarkable features of the enterprise; notwithstanding the complexity of the work, there has not been the slightest friction. I believe no other international enterprise of like magnitude has been called into existence or worked more smoothly. . . .

As war went on, it became necessary for the society to evaluate its responsibilities towards the catalogue. It was decided that the society could not guarantee the publication of the catalogue beyond the fourteenth issue. An issue consists of seventeen volumes, each dealing with a separate science. The fourteenth issue is now being published, and it is noteworthy that special contributions in aid of publication have been made by the Carnegie Foundation of New York, by the Department of Scientific and Industrial Research, and by certain private donors.

The Royal Society has also undertaken the direct control of the enterprise during the period of the war. Early last year it was intimated to workers abroad that the future of the catalogue must be left for the decision of an international council to be called as soon as possible after the conclusion of peace.

Why the Conjoint Board has intervened is not clear. It certainly has no right to give the catalogue its quietus. That it should have taken the action it has *without ever consulting the international organization* passes belief.

I attended the meeting of the board on Wednesday last, and protested most strongly against the discourtesy the subcommittee has displayed towards our Allies and the neutral countries concerned in the enterprise.

It is unnecessary to dwell on the special need at the present time of maintaining and cementing relationships that have been so happily established, and to comment further on the unhappy policy adumbrated by the subcommittee.

PRIZES OFFERED BY THE AMERICAN FISHERIES SOCIETY

IT is announced in the *Fisheries Service Bulletin* that in order to develop interest in fish culture and related subjects, and to stimulate expression regarding them, the American Fisheries Society has, through its president and executive committee, decided to offer three prizes of $100 each to be awarded at its meeting in New York state in September, 1918, as follows:

1. For the best contribution on fish culture; either new or improved practical fish-cultural appliances, or a description of methods employed in the advancement of fish-cultural work.

2. For the best contribution on biological investigations applied to fish-cultural problems.

3. For the best contribution dealing with the problems of the commercial fisheries.

A committee of three members of the society, one a practical fish-culturist, one a scientist, and one a practical commercial fisherman, to be appointed by the president, will pass upon the material submitted. The conditions governing the competition are as follows:

1. Any person who is a member of the society, or who duly qualifies as a member prior to September 1, 1918, may compete for the awards.

2. Each competitor is to notify the secretary of the society, John T. Titcomb, state fish-culturist, Albany, N. Y., before September 1 of the particular prize for which he intends to compete.

3. Each paper or exhibit offered in competition is to be in the custody of the secretary of the society on or before September 3, 1918.

4. Each device, apparatus, process, or method offered for an award is to be presented by a sample, model, or illustrated description, each to be accompanied by a complete statement of the points for which an award is asked.

The society is to reserve the right to publish any papers or photographs submitted in competition prior to their publication elsewhere; provided, however, that in the event of failure to publish within nine months after the meeting the author will be at liberty to publish when and where he may elect.

5. The committee appointed by the president is to determine the competitors who are entitled to awards, and the decision of the committee is to be final.

6. In order to obtain additional information if desired the committee may call before it persons who may have entered the competition, and also other persons.

7. The committee is to make its final report to the society not later than the morning session of the third day of the meeting.

THE MEDALS OF THE GEOLOGICAL SOCIETY OF LONDON

AT the anual meeting of the society on February 15, the president, Dr. Alfred Harker, handed the Wollaston Medal, awarded to Dr. Charles Doolittle Walcott, to Mr. William H. Buckler, attaché to the Embassy of the United States of America in London for transmission to the recipient, addressing him as follows:

The Wollaston Medal, the highest honor at the disposal of this society, is conferred upon Dr. Charles Doolittle Walcott in recognition of his eminent services to geology and paleontology, more particularly among the older fossiliferous rocks of North America. While his administrative work, both on the United States Geological Survey and at the Smithsonian Institution, has done much for science in his own country, his personal researches have excited interest and admiration wherever geology is cultivated.

He has made important contributions to the history of the Algonkian formations, and his discoveries lead us to hope that the less altered of those ancient sediments may ultimately yield more abundant and definite relics of pre-Cambrian life.

His detection of fish remains in the Ordovician rocks of Colorado, again, carried back by a stage the earliest appearance of vertebrates in the succession of life forms. But it is in the Cambrian strata that Dr. Walcott has found chief scope for his labors, which, pursued principally upon the American continent, have often had a world-wide importance. Realizing the dual part which the exponent of paleontology is called upon to sustain, he has illuminated that science alike in its geological and in its biological aspect. Under the former head should be mentioned the determination and collation of the stratigraphical sequence in numerous districts, and the light thrown thereby upon the problems of paleophysiography. In particular, Dr. Walcott's study of the geographical distribution of the Cambrian faunas, establishing the existence of two distinct provinces, marked a signal advance in this field. On the biological side his work has been no less fruitful in results. It is sufficient to recall the series of memoirs dealing with the Trilobites, in which he greatly elucidated the organization of that important group, and again his two handsome volumes on the Cambrian Brachiopoda.

In recent years, with energy which a younger man might envy, he has pushed his researches into the Rocky Mountains of Canada, amidst scenery which his beautiful photographs have made known to many. There he has been rewarded by the bringing to light of two richly fossiliferous horizons in the Middle Cambrian succession, including in one an assemblage of fossils marvelous for the perfect preservation of their detailed structure. The preliminary account of the discovery has aroused keen interest, and paleontologists eagerly await the full description by a master hand of this unique collection.

If by his official status, joined with his personal record, Dr. Walcott is in some sense representative of American geology, with its large opportunities so ardently embraced, the occasion may remind us that community of scientific interests is perhaps not least among the links which unite your country to ours. I have much pleasure, Sir, in placing this medal in your hands for transmission to its recipient, and trust that his future career may include achievements no less brilliant than those which we commemorate to-day.

In handing the Murchison Medal, awarded to Joseph B. Tyrrell, to the Hon. Sir George Halsey Perley, high commissioner for the Dominion of Canada, for transmission to the recipient, the president addressed him as follows:

The Murchison Medal has been awarded to Mr. Joseph B. Tyrrell in recognition of the value of his many services to geological science. In the breadth of their scope, in the pioneer element which has so largely entered, in the practical benefits which have often followed, those services may stand as typical of Canada's contribution to geology.

During more than thirty years Mr. Tyrrell has been frequently engaged in exploiting wide tracts of the little-known Barren Lands of northern Canada, making prolonged journeys of a kind which demands no ordinary resolution and endurance. Besides thus adding largely to geographical knowledge by his own efforts, he has done much to make known the results of earlier explorers in the north. While helping very materially to develop the mineral resources of the Dominion, he has at the same time gathered much valuable information touching the older rocks of the region; and, uniting in his own person the geologist and the prospector, he has often shown by example how science and enterprise may go hand in hand, to the great advantage of both.

On the side of pure science, however, his most notable researches have been in the domain of glacial geology, where his extensive acquaintance with the country has enabled him to arrive at conclusions of a large order. Prior to 1894 it was generally held that the ice which once overspread Canada, east of the Cordillera with its mountain glaciers, emanated from a single center of dispersal. Mr. Tyrrell first demonstrated the existence and approximate limits of a great ice sheet, which he named the Keewatin, centering in the country west of Hudson Bay and distinct in origin from the Labradorean ice sheet on the east. To these two he subsequently added a third, under the name of the Patrician Glacier, which had its gathering-ground to the south of Hudson Bay. His development of this thesis, involving a discussion of the relations in time and space of the ice sheets radiating from different centers, must rank among the most important contributions to the glacial history of North America.

In forwarding to Mr. Tyrrell this token of recognition from the council of the Geological Society, I beg, Sir, that you will add to our congratulations upon what he has already accomplished our hope that many years of activity still remain to him; and this wish will, I am sure, be echoed by his numerous friends on both sides of the Atlantic.

SCIENTIFIC NOTES AND NEWS

A BOARD of medical officers, consisting of Colonels Deane C. Howard, M.C., U. S. Army; Frederick F. Russell, M.C., U. S. Army; Victor C. Vaughan, M.C., N. A.; Lieutenant-Colonel William H. Welch, M.C., N. A., and Contract Surgeon Rufus Cole, has been appointed for the purpose of making an investigation as to the nature, causes and prevention and treatment of pneumonia, and its complications, in the various military camps in the United States. It will report from time to time to the surgeon-general of the army, to whom a full report will be made as soon as practicable after the completion of the investigation.

MAJOR A. J. CARLSON, S.C. N. A., attached to the Food Division or the Surgeon-General's Office, is at present on duty in England making a study of food conditions in the rest camps of the United States Army.

MAJOR SAMUEL C. PRESCOTT, S.C., N. A., attached to the Food Division of the Surgeon-General's Office, has just returned from a tour of southern camps in which he was making an inspection of the conditions of storage as affecting the healthfulness of foods supplied to troops in training.

THE following named officers of the Food Division, Surgeon General's Office, are on duty in France: Major Philip A. Shaffer, Captains Walter H. Eddy, Arthur W. S. Thomas, F. B. Kingsbury and M. G. Mastin, all S.C., N. A.

DR. GEORGE E. VINCENT, president of the Rockefeller Foundation, who had been on a trip of nearly three months to Italy, France and England, arrived in New York on June 1, accompanied by Dr. Livingston Farrand, president of the University of Colorado, who had been in charge of the foundation's tuberculosis work in France for a year.

THE close of the present year at Western Reserve University will be marked by the retirement of Professor F. P. Whitman, who has held the chair of physics and astronomy at Adelbert College for thirty-two years. Professor Whitman, who was born in Troy, New York, was graduated at Brown University in 1874.

SWARTHMORE COLLEGE at its commencement, on May 20, bestowed the honorary degree of doctor of letters upon Provost Edgar F. Smith.

AT its recent commencement Syracuse University conferred the honorary degree of doctor of science on Professor Albert Perry Brigham, of Colgate University.

THE University of Pittsburgh has conferred its doctorate of science on Raymond Foss Bacon, director of Mellon Institute, University of Pittsburgh, and lieutenant-colonel in charge of the chemical work of the American forces in France, and on George Coffin Johnston, professor of roentgenology in the University of Pittsburgh, and major in the medical corps, the doctorate of engineering, on Walter Victor Turner, pneumatic expert with the Westinghouse interests, and the doctorate of chemistry on Arthur Dehon Little of Boston.

IN recognition of his distinguished work at Yale University, Joseph Barrell, '00, Ph.D., professor of structural geology, has been elected to honorary membership in the Phi Beta Kappa Society.

DR. J. BISHOP TINGLE, professor of chemistry at McMaster University, Toronto, has been elected a fellow of the Royal Society of Canada.

SIR THOMAS R. FRASER, who succeeded Sir Robert Christison as professor of materia medica in the University of Edinburgh in 1877, has tendered his resignation, to take effect at the end of the present year.

DR. R. S. HEATH, professor of mathematics at Birmingham University, vice-principal and registrar, has announced his intention to retire owing to ill-health.

THE War Industries Board has created a commodity section on medicines and medical supplies, with Lieutenant Colonel F. F. Simpson as its chief.

DR. THOMAS L. WATSON, professor of geology in the University of Virginia and state geologist of Virginia, has been engaged for

some months in cooperative state and federal work on war minerals and materials in Virginia. He is a member of the subcommittee of the National Research Council on materials for rapid highway and railroad construction behind the front, and an associate member of the war minerals committee.

Mr. W. S. Fields has resigned as assistant plant pathologist in the Arkansas Experiment Station to take up work as extension plant pathologist under the Bureau of Plant Industry, with headquarters in Mississippi.

The Bureau of Fisheries has engaged Professor J. Percy Moore, of the University of Pennsylvania, for investigation of fishes and other aquatic animals in relation to mosquito control in northern regions. For the present, at least, his investigation will be conducted in the general vicinity of Philadelphia.

The following men have been called for military service from the botanical department of the Michigan Agricultural College: Mr. C. F. Murphy and Mr. C. W. Bennett, graduate assistants in botany, and Mr. Ray Nelson, research assistant in plant pathology.

The geologists of the Ohio Academy of Science for their spring meeting made an excursion to the southern part of the state. The party, twelve in number, left Columbus at noon on May 31 and returned late on June 2. The Silurian formations of Highland county were visited under the lead of A. F. Foerste, and the Mississippian and Pennsylvania of Pike and Jackson counties under the lead of J. E. Hyde and Wilber Stout. Stops were made at the Serpent Mound in Adams county and at Camp Sherman.

Four curators of the Museum of the University of Pennsylvania are now in the army, while two others are in Egypt excavating for the Eckley B. Coxe, Jr., Expedition and can not return until after the war. Dr. Stephen Langdon, curator of the Babylonian section, is in the British army and will remain there during the war. He is professor of Assyriology at Oxford University, but was given permission last year to come to this country and accept the post of curator on condition that he give one course of lectures a year in Oxford. Owing to raising the age limit he was not permitted to leave England this spring and is serving with the colors. Dr. William C. Farabee, who led the museum's Amazon Expedition for three years, has just been appointed a captain in the intelligence corps and will soon leave for service. Stephen B. Luce, of the Mediterranean Section, has been appointed a lieutenant in the Navy and is now in service. H. U. Hall, assistant curator of the American Section, is serving in France with the Keystone Division.

The Royal medals of the Royal Geographical Society, London, have been awarded by the council as follows: The founder's medal to Miss Gertrude Bell, for her important explorations and travels in Asia Minor, Syria, Arabia, and on the Euphrates; the patron's medal to Commandant Tilho, French Colonial Infantry, for his long-continued surveys and explorations in northern Africa. Owing to the shortage of gold the medals will, with the King's approval, be struck in bronze instead of gold, and the balance of their value be given in war bonds. The other awards are as follows: The Murchison grant to Mr. C. A. Reid, for his maps of the Belgian Congo, which he has placed at the disposal of the society; the Cuthbert Peek grant to Mr. G. F. Archer, for his surveys in East Africa connecting Major Gwynn's Abyssinian triangulation with the triangulation of East Africa; the Back grant to Captain Bartlett, for his distinguished leadership after the loss of the *Karluk;* the Gill memorial to Major Cuthbert Christy, R.A.M.C., for his surveys and explorations in central Africa.

Dr. William Townsend Porter, professor of physiology in the Harvard Medical School, will be the commencement speaker at Milton Academy on June 15.

Professor William S. Franklin, of the department of physics of the Massachusetts Institute of Technology, lectured before the Washington Academy of Sciences, on June 7, on "Some needed lines of research in meteorology."

DR. E. E. SOUTHARD, of the Harvard Medical School and the Massachusetts State Psychopathic Hospital, gave a lecture on May 14 at the University of Chicago on "War neuroses after the war."

THE Ramsay Memorial Fund, founded under the presidency of Mr. Asquith to raise £100,000 for Ramsay Memorial Fellowships in chemical science, and a laboratory of engineering chemistry at University College, London, has made considerable progress in recent months. Subscriptions and promises to date amount to £32,600. The latest donations include: M. Eugène Schneider, £500; Lady Durning Lawrence, £100 (second donation); Sir G. H. Kenrick, £100; Académie des Sciences de l'Institut de France (of which Sir William Ramsay was a corresponding member), £80; the Fertilizer Manufacturers' Association, £52 10 s.; his Highness the Maharaja Dhiraj of Patiala, £50. "Memorials of the Life and Work of Sir William Ramsay," by Sir William A. Tilden, will be published shortly by the Macmillans.

IN memory of Lieutenant William T. Fitzsimon, Kansas City, who was killed last September, when the German airplanes bombarded the Harvard University Hospital in France, the park commissioners of Kansas City have decided to erect a memorial in the form of a public drinking fountain which will bear an inscription relating the details of Dr. Fitzsimon's work and death.

CHARLES CHRISTOPHER TROWBRIDGE, assistant professor of physics in Columbia University, died suddenly on June 2, aged forty-eight years. Dr. Trowbridge was the author of researches on fluorescence and phosphorescene in gases and also on physical aspects of the flight and migration of birds.

DR. JOSEPH DENIKER, the distinguished French anthropologist, died on March 18, aged sixty-six years. Dr. Deniker, who was chief librarian of the Paris Natural History Museum, was born in Russia.

ALFRED GORDON SOLOMON, of London, known for his contributions to the chemistry of brewing, has died in his sixtieth year.

UNIVERSITY AND EDUCATIONAL NEWS

A GIFT of $400,000 to the Massachusetts Institute of Technology was announced by President Richard C. Maclaurin at a meeting of the corporation on June 7. The name of the donor was not made public. The income of the fund will be used for general purposes of the institute during the war and thereafter applied to the development of courses in chemistry and physics.

THE alliance between Columbia University and the Presbyterian Hospital, which was first made in 1911, and was planned to result in the establishment of a great medical center in New York City, has been cancelled by the managers of the hospital. Columbia University was unable to obtain the money needed for its share of the buildings and rejected the plans proposed as a condition of an endowment from the Rockefeller Foundation.

DR. JOHN T. FAIG, professor of mechanical engineering in the University of Cincinnati, has been appointed president of the Ohio Mechanics Institute, succeeding Professor John Shearer, who has been head of the institute for twenty years. Professor Faig is now taking charge of the college of engineering in the absence of Dean Herman Schneider, who is engaged in military service in Washington.

DR. F. OCARANZA, professor of physiology at the University of Mexico, has been appointed secretary of the faculty of medicine. He is at the same time secretary of the Academy of Medicine.

THOMAS J. MACKIE has been appointed professor of bacteriology in the South African Medical College, Cape Town.

DR. T. FRANKLIN SIBLY, of University College, Cardiff, has been appointed professor of geology at Armstrong College, Newcastle-upon-Tyne, in succession to the late Professor Lebour.

DISCUSSION AND CORRESPONDENCE

DESMOGNATHUS FUSCUS AGAIN

IN SCIENCE (N. S., Vol. 47, Apr. 19, 1918, pp. 390–391) Professor H. H. Wilder under the heading "*Desmognathus fuscus* [sic]" has

much to say about the grammatical sins of biologists in the use of systematic names. These I am not defending, nor is it my intention here to analyze the motives which induced the International Zoological Congress to refuse to sanction subsequent correction of such errors. But the case which serves him for a heading is of a different nature. He characterizes Spencer F. Baird's use of the combination *Desmognathus fuscus* as a "mistake" which "was followed by several illustrious men, both anatomists and systematists, among others by Wiedersheim (1887), W. K. Parker (1879), Boulenger (1882), and as late as 1909, by Gadow." I think it can be shown, however, that these illustrious men, as far as the grammar is concerned, were as correct as the other zoologists quoted by him, who wrote *Desmognathus fusca,* both forms being grammatically correct.

The rule governing the gender of Greek composite words is, as I understand it, that the unmutated composites follow the gender of the final component. Thus *dermatochelys* is feminine because *chelys* is feminine, *chelys* being Greek for turtle, and *dermatochelys* for a leather-back turtle.

Mutated composite words, on the other hand, except personal names, are of common gender, that is, they may be used either as masculines or feminines. Thus *kallithrix* as a zoological appellative may be used either as a masculine or as a feminine noun, notwithstanding the fact that *thrix,* hair, is feminine.

As an example of the above rule, let us examine a familiar word commonly used in forming zoological generic appellatives, for instance, *rhynchos,* a beak, a bill (*rhamphos* might just as well have been chosen). The gender of this Greek word is neuter. Now, were I to describe and classify beaks only, I might speak of a *goniorhynchos* and of an *orthorhynchos* according to whether the beak were angular or straight, and these composite words being unmutated would also remain neuters. But when I designate a fish or a bird as *Goniorhynchus* or *Orthorhynchus* meaning a fish with an angular beak or a bird with a straight bill, these appellatives assume the common gender and the specific adjectives may be masculine or feminine according to my choice. Thus it would be grammatically correct to say either *Goniorhynchus albus* or *Goniorhynchus alba,* but certainly NOT *Goniorhynchus album,* in spite of the fact that *rhynchos* is neuter.

Similarly, if one were to speak of a jaw as a *desmognathos,* its gender is undoubtedly feminine, *gnathos* being feminine, but naming, as Spencer F. Baird did, a salamander *Desmognathus* he created an appellative of the common gender and he was at perfect liberty to use the masculine form of the adjective *fuscus* in conjunction with it. He certainly committed no grammatical blunder "in all its shame." Equally correct was Dr. J. P. Moore when he instituted the genus *Leurognathus* for another salamander and named the species *Leurognathus marmorata.*[1]

It will thus be seen that Baird and those who follow him have not "changed the grammatical gender of the noun *gnathos,*" but have simply availed themselves of their right to select from the common gender of the salamander *Desmognathus* that which in their opinion was most consistent with general zoological practise. This, it is interesting to note, has been to regard the mutated appellatives formed by combination with *gnathos* as of the masculine gender.

Thus the mammalian genus *Perognathus* of Wied was originally proposed as masculine and generally so accepted. *Erignathus* was proposed by Theo. N. Gill as masculine and has been universally so accepted. Among snakes we have *Leptognathus,* by Duméril and Bibron designated as masculine and so accepted by Günther, Jan and Cope; *Lycognathus, Ischnognathus* and *Petalognathus,* similarly proposed, and also accepted by Boulenger. Among the frogs we have *Cystignathus fuscus* Günther; *C. ocellatus* Tschudi, Peters; *C. labyrinthicus* Duméril and Bibron, Reinhardt

[1] The erroneous quotation *Leurognathus marmoratus* in the check list referred to by Professor Wilder was due to a lapsus and the use of the masculine gender in this case was quite unintentional. The incorrect citation of Dunn's *D. ochrophæa carolinensis* is also greatly regretted.

and Lütken, Steindachner; *C. pentadactylus* Peters; *C. mystacinus* Burmeister; *C. podicipinus* Cope, etc. Generic names ending in *gnathus* are as rare among birds as those ending in *ryhnchus* and *ramphus* are common (and needless to say no ornithologist, or other zoologist, has used the latter as neuters), but we have at least *Hemignathus* which they have accepted as masculine without exception, among them the purist of purists, Dr. J. Cabanis who is responsible for *Hemignathus procerus*. Finally, giving a few examples from the fishes, I quote *Hybognathus* accepted as masculine by Girard, Jordan and Gilbert, *Cochlognathus* by the same authorities, and last but not least *Syngnathus* proposed as a masculine by Linnæus himself and so accepted by all subsequent ichthyologists. In fact, it is probably not too risky to say that not until Cope discovered that the unmutated *gnathos* is feminine (reversing his own previous practise), were any of the mutated composites treated as feminine. It is also safe to say that most of the illustrious men who adhered to the masculine gender, when so indicated by the original proposer of the name, knew what they were about and showed proper "respect to the Greek language."

LEONHARD STEJNEGER

EVOLUTION OF BACTERIA

I WAS greatly interested in Professor Buchanan's article in SCIENCE[1] entitled "The Evolution of Bacteria." It is not my intention at the present time to take up at length those points raised by him which are admittedly matters of opinion. In matters of classification, there are many possible interpretations of available facts, which can not be easily proved or disproved. The conclusions reached were based on the facts at hand, though it was admitted at the outset that the facts were inadequate. The final answer to these questions can not be obtained at the desk, but in the laboratory. Most of the questions concerning bacterial relationship and descent can be tested experimentally by a study of their metabolic and antigenic characters, and it is such investigations that my article was intended to stimulate.

Dr. Buchanan did, however, raise certain questions of fact which require some comment. In my argument in favor of the primitive character of bacteria the unique combination of the ability to subsist on simple inorganic compounds plus an extreme sensitiveness to sunlight, which excluded aid from that source, was advanced. This combination does not obtain in either plant or animal cells. Cells so constituted as to live on simple inorganic compounds without the aid of an external source of energy may, it seems to me, reasonably be considered as primitive. The sulphur bacteria, mentioned by Dr. Buchanan, contain a pigment which protects them from sunlight and which according to Englemann apparently functions somewhat like the chlorophyl in plants. Molisch dissents from Engelmann's view but claims that these bacteria must have organic food for their nutrition. Why they should be considered more primitive than the prototrophic bacteria is, therefore, not altogether clear.

In regard to the source of the volatile acids and alcohols for bacterial nutrition, I might refer to Kaserer's[2] report of nitrifying bacilli which convert $(NH_4)_2CO_3$ to formic acid and free N, or nitrates. These compounds are not, therefore, necessarily the product of carbohydrate fermentation.

The author draws the inference that by utilization of CO_2 I had in mind oxidation. It requires no profound knowledge of chemistry to realize that such a thing is not possible. What was implied throughout was an ability on the part of the cell to assimilate CO_2. Instances of such assimilation are numerous and this power is particularly evident among the nitrogen-fixing bacteria, the energy apparently being obtained from the oxidation of the N with a simultaneous reduction of the CO_2.

Reports of prototrophic denitrifying bacteria are admittedly not "common and well known." They have, however, been described by Hiltner and Strömer.[3] Somewhat more

1 SCIENCE, 1918, N. S., XLIII., 320.

2 *Cent. f. Bakt.*, II. Abt., 1908, XX., 401.

3 *Ref. Bot.*, 1904, XCV, 157.

advanced types flourishing in inorganic media containing nitrates and ethyl-alcohol have been described by Hohl[4] and by Burri and Stutzer.[5]

Because a group has not been extensively studied is no proof that it is not common. It is sufficient that representative types have been described. The group may well be common and yet not well known. The diphtheroids, the aciduric bacilli, the cellulose fermenters, are quite common, but were not well known five to ten years ago.

The resemblance between the red and yellow bacilli and the red and yellow cocci is only a superficial one. They produce pigments of the same chrome, but the pigments produced by the two classes of bacteria are *not* of the same type. The pigments produced by the cocci belong to the lipochrome group, give the typical lipocyanin test and their production is not affected by temperature. The pigments produced by the red bacilli do not give the lipocyanin test and their production is markedly affected by temperature. There are in addition marked metabolic differences between these two groups of organisms. The *B. prodigiosus* and related bacilli are more actively fermentative and many produce gas—largely CO_2. They as a rule liquefy gelatin actively while the red cocci as a rule do not. The bacilli are facultative anaerobes, the cocci are almost strict aerobes.

The ability on the part of *B. aerogenes* to fix nitrogen was reported by Lohnis[6] who studied the behavior of a considerable number of bacteria in this respect.

In conclusion I grant that my thesis has not been proved. Neither has it been disproved. If it stimulates investigation along these lines the paper will have been justified.

I. J. Kligler

ORGANIC CHEMICALS FOR RESEARCH, OR THE NEED OF A PHILANTHROPIST

Professor Roger Adams has recently published in these columns[1] an account of the admirable work which the laboratory of organic chemistry at the University of Illinois is doing to keep up the supply of certain organic chemicals for research and industrial needs. However, when one compares the limited list which that laboratory is manufacturing with the lists in the catalogues of German chemical firms, the realization comes home that the rarer organic preparations are no longer available and probably will not be available as long as the war lasts, and that, unless some measure is taken to prevent such an occurrence, Germany will again regain her trade in this line after the war.

It is well enough to *say* that we will not use German-made goods, but there would appear to be only one alternative, *i. e.,* the cessation, or at least the slowing up of research in organic chemistry if these essential starting materials are not available, or if they are available at relatively enormous prices.

The question therefore arises in my mind: "Why can not some man of wealth make his name blessed by endowing a laboratory which shall prepare these rarer organic chemicals against the needs of research work?" Undoubtedly the German supply houses sold many of these products at a loss before the war, counting the loss as a necessary part of their advertising propaganda, which was meant to build up the idea that Germany was the great chemical center of the world. Our commercial firms, unfortunately, do not see things in that light, and usually refuse to follow paths where a sure and handsome profit does not lead them.

If some man of wealth can not be found to whom this suggestion would appeal, what is there to prevent one of our research foundations from supplying the need? How could research and discovery be better furthered in this particular field of science than by furnishing the essential basic materials to a host of research workers in our colleges and universities? If such a plan as is herein proposed were adopted the United States would without doubt secure and retain first rank in the field of organic research. The initial cost would be comparatively small as measured by the scientific results, for the in-

[4] *Land Jahr. der Schweitz,* 1906, 510.
[5] *Cent. f. Bakt.,* II. Abt., 1895, I., 257.
[6] *Cent. f. Bakt.,* II. Abt., 1907, XIX., 87.
[1] Science, 47, pp. 225–228, March 8, 1918.

vestigators' salaries would be borne by the colleges and universities and where now a research foundation is giving to scientific investigation the services of one man, the same sum would assist a score or more of investigators.

In my own laboratories approximately half of the time of the investigators' laboratory work must of necessity be devoted to the preparation of essential starting-materials, pure amino acids, proteins, organic compounds, etc., in order to later use these for investigational purposes. These compounds are not available on the market except at exorbitant prices, tyrosine, for example, being quoted at $5.00 a gram (when obtainable), a price utterly out of proportion with the cost of preparation.

When one considers the limited funds available for research apparatus and chemicals in our colleges and the excessive cost of these materials, it is not surprising that no more research work is done; the surprising thing is that so much is done. The chemistry budget for our smaller colleges is usually $350–$600 per year and will probably not exceed $3,000 in many of our larger institutions. From this sum is first purchased the necessary equipment of apparatus and chemicals for the undergraduate laboratory courses and *if any funds remain* research chemicals or apparatus are secured. Unfortunately in many instances no funds remain for research work, the instructor can not prepare the compounds needed, for his time is too largely taken up by teaching, with the result that his research aspirations slowly die, for they have no soil upon which to grow. The question may arise: "Why does not such a man prepare his basic materials even if his time is limited?" In the first place there is no glamor in such work. In the second place, there are often eight or ten synthetic steps from raw products to finished material, and the necessary chemicals and apparatus for certain of these steps are not available. The rarer chemicals of which I am thinking represent in themselves end products of research (already published) and many of our college laboratories are not equipped for these steps, although they may be equipped to use the final product as the starting material for another investigation. It may be that the production of an intermediate product depends on a distillation in a vacuum of 0.01 mm. and no high-vacuum pump is available, etc.

Such an endowed laboratory as I have in mind would be in charge of an organic research chemist and would prepare and keep in stock all sorts of organic compounds for research workers. If an investigator desired a certain compound he could obtain this without cost or for a nominal cost providing that he first convinced the director of the laboratory that there was an actual need for the compound and that it would be used in bona fide research work, acknowledgment of such a grant to be appropriately made in the published results. If, on the other hand, an industrial demand for the chemical should arise (such as that which did arise due to the depleted supplies of dimethylglyoxime after the war began), the laboratory should charge a fee at least large enough to cover the cost of preparation. This would prevent the possibility of exploitation and in any event it should be definitely specified that there should be no resale of the article in question and any supply remaining after the completion of the approved research should revert to the endowed laboratory.

The above plan is probably not perfect, but I feel that there is in it at least a suggestion worthy of the serious thought of our scientific men or scientific societies, and I only hope that in some manner it may bear fruit. We must not again be dependent upon Germany for our research needs and unless some such endowed laboratory is brought into existence I can see no other alternative.

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SCIENTIFIC BOOKS

Electrical Measurements. By FRANK A. LAWS. New York, McGraw-Hill Book Company, Inc., 1917. xiii + 719 pp. Price $5.00.

During recent years, writers of laboratory manuals have exhibited a constantly increas-

ing tendency to confine themselves to detailed directions for the performance of a number of more or less well selected but highly specialized electrical measurements. Such methods provide an easy introduction to the technique of the electrical laboratory and they are frequently useful in dealing with elementary students provided the underlying principles and their interrelations are clearly emphasized. But, when they become crystallized in book form, the several experiments are apt to occupy watertight compartments, between which the student sees very little relation. He performs the specified manipulations and draws the specified conclusions without obtaining the slightest inkling of their significance in electrical science, because he has been relieved of the study necessary for understanding. Moreover, owing to variations in equipment, even the best of such books are of little use except in the laboratories for which they were written.

Professor Laws's book is a welcome departure from these methods and can not fail to be greatly appreciated by serious students of electrical science. It is a clear and comprehensive treatise on modern methods of electrical measurement and includes sufficient discussion of typical instruments to guide the student in their practical application whatever may be the type of the instruments with which he has to deal. A few methods of purely historical interest are described, but for the most part the methods and instruments discussed are so thoroughly up to date that many of the more recent developments can be found elsewhere only in the original publications of their authors. Numerous references to original sources direct the student to first-hand discussions of the topics treated and to special methods and details beyond the scope of the present work.

The following list of chapter headings gives an idea of the field covered by the book: Measurement of Current; The Ballistic Galvanometer; Resistance Devices; Measurement of Resistance; Measurement of Potential Difference and Electromotive Force; Power Measurement; Measurement of Inductance and Capacity; Induction Instruments; Electricity Meters; Phase Meters; Power-factor Indicators; Synchroscopes and Frequency Meters; Graphic Recording and Curve Drawing Instruments; Instrument Transformers; Calibration of Instruments; Determination of Wave Form; Cable Testing.

The theory of methods and instruments is logically developed from fundamental principles and the conditions necessary for accuracy are discussed at some length in connection with practical applications. Galvanometers of various types are treated with the fulness merited by their general use as indicating and measuring instruments. The equation of motion of the suspended system is developed and integrated in its general form. Special cases are then derived by suitable choice of initial conditions and dynamical constants. The results thus obtained are utilized throughout the book in discussing the proper adjustment of resistance, control torque, period, damping factors, deflecting couple and sensitiveness to meet the requirements of the various uses of the galvanometer.

The typography of the book is clear and well arranged. The few misprints, inevitable in a first edition, are apparent and easily corrected. Most of the diagrams and illustrations are clear and well executed but a few of the halftones do not give a very clear idea of the instruments represented. The reader is assumed to be familiar with the fundamental principles of direct and alternating current systems of distribution and with the methods of differential and integral calculus. With this equipment he should find no difficulty in following the author's clear and concise discussions. The book is well adapted for use in senior college laboratories and it should also find a place in the working library of every electrical engineer.

A. deForest Palmer

SPECIAL ARTICLES

A NEW AND IMPROVED METHOD FOR OBTAINING PECTIN FROM FRUITS AND VEGETABLES

For more than two years past the writers have been engaged in the study of methods for

the isolation and purification of pectin. The studies, which were for the most part carried on at the Washington Agricultural Experiment Station, were at first concerned with the preparation and concentration of pectin for household use.[1] This work led to attempts to develop practical and inexpensive methods for the isolation of pectin in a pure state which should be equally available for the household or for commercial use. Such a method was developed and perfected in the autumn of 1917, but the transfer of the authors from the Washington Station to this office has delayed the preparation of a detailed report of the results for publication. The purpose of this preliminary note is to make the method immediately available pending the publication of a detailed paper now in the hands of the editor of the *Journal of Agricultural Research*.

The method is available for use with any pectin-containing material, since the objectionable flavoring substances of such materials as carrots are entirely removed.

The pectin is extracted from the material by the usual method of pulping, boiling with water and draining, this process being repeated until the pulp is exhausted. The watery extracts are combined, cooled, and a small quantity of a saturated solution of commercial alum, the exact amount being determined by the viscosity of the liquid, is slowly added and thoroughly mixed with the solution. Ammonia is now added in an amount slightly greater than that necessary to neutralize the acidity of the solution or until no further precipitate is formed. Precipitation will not occur if the solution is a concentrated, viscous one, and in all cases warming, or preferably diluting with hot water, hastens the coagulation of the precipitate and the clarification of the liquid. The voluminous insoluble precipitate of aluminum hydrate holds and carries out with it suspended solids and a considerable portion of the coloring matter.

As soon as the clarification is completed the solution is filtered and the residue upon the filter paper is preserved and dried for subsequent recovery of the aluminum. An ordinary laboratory grade of filter paper permits rapid filtration and retains the precipitate perfectly.

The water-clear filtrate, which contains only pectin, sugars, and traces of coloring matter, is heated to boiling, and magnesium-sulphate crystals are added, with constant stirring, until the formation of the flaky, grayish precipitate of pectin has ceased. The solution is then passed through filter-paper, preserving the filtrate, and the precipitate is freed from magnesium sulphate by washing with cold water and dried. The dry preparation may be readily reduced to a grayish powder, insoluble in cold water but readily soluble in warm acid solutions. It is entirely free from the coloring and flavoring matters of the material from which prepared. It may consequently be employed in making jellies from even the most delicately flavored fruit juices without danger of introducing foreign flavors. This makes possible the use not only of fruits but also of such pectin-rich but hitherto unavailable materials as the carrot as sources of pectin for jelly-making purposes. By reason of the purity of the product made by this method, it may be kept for prolonged periods in the dry condition without deterioration. In comparison with the ordinary commercial concentrated pectin there is an enormous reduction in volume and in cost of storage and transportation, a considerably decreased cost of production with a wider variety of raw materials available as sources, and a greatly increased range of usefulness.

An especially valuable feature of the process is that the chemicals employed may be almost completely recovered, thus reducing the cost of the process to a minimum. The aluminum salt is recovered as aluminum oxide by incinerating the residue from the first filtration. The magnesium sulphate is recovered as such from the final filtrate by concentration and the addition of a small quantity of alcohol, which causes the prompt crystallization of the salt, leaving coloring matters and sugars in solution in the dilute alcoholic liquid. Purifica-

[1] Caldwell, J. S., "A New Method for the Preparation of Pectin," *Wash. Agric. Expt. Sta. Bull.*, 147: 1–14, April, 1917.

tion of the magnesium sulphate is completed by washing the crystals with very dilute alcohol, after which they may be immediately used for further precipitation.

In the complete paper the authors will discuss in some detail the application of this method to the quantitative determination of pectin in the laboratory or in commercial jelly-making establishments. It is considered especially desirable at this time to point out that precipitation by magnesium sulphate may advantageously supplant the use of alcohol in the household test for pectin. While alcohol is not ordinarily available to the housewife, Epsom salts are to be found in every home and in almost every grocery store. By heating a small quantity of the aqueous extract of fruit, dissolving Epsom salts therein, and observing the amount of pectin thrown out of solution, one obtains an accurate measure of the pectin content of the fruit and is thereby enabled to form a judgment as to the amount of sugar necessary to form a jelly.

Discussion of many details of technique and of certain applications of the method here presented in outline are necessarily reserved for presentation in the full paper immediately forthcoming in the journal already named.

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THE CARE AND BREEDING OF ALBINO RATS

At this time when the government is using great numbers of albino rats and mice for inoculation purposes, numerous letters have been received from various sources asking for information regarding a source of supply and the care and breeding of these animals. This demand is so widespread that it is deemed most expedient to give this information in a simple form and to disseminate it to the greatest number of people by publishing it in this journal. In so doing those persons who are anxious to do their bit in this present crisis and who reside sufficiently near base hospitals and cantonments may be able to rear and supply these animals.

Albino rats and mice are exceedingly easy to raise. Their care and feed are practically the same and the cages in which they are kept can be identical. The cages for mice can, however, be much smaller. Our colony at the present time consists wholly of rats and the following applies strictly to them. It in general applies to mice also. These animals can ordinarily be handled by the bare hands without any danger of being bitten. Occasionally, however, a mother with young may be less docile if her young are disturbed. In such cases the use of a pair of heavy gloves is advisable. The oftener the rats are handled and petted the less likely they are to bite.

The cages in which our rats are kept and which we have found most satisfactory are made of one-fourth-inch galvanized wire netting with all the corners, edges and doors bound, or reënforced by galvanized iron (Fig. 1). They are made 12 inches high, 18 inches wide and 24 inches long. A partition of woven galvanized wire, provided with a sliding door (*D* 4 in. × 4 in.), divides this into two compartments 12 in. × 12 in. × 18 in. Each of these compartments is provided with a woven wire door (*D*, 6 in. × 6 in.) which slides up in runners made of galvanized iron (*Rn*). These doors are of ample dimensions to enable one to easily reach into all parts of the cage.

The bottom is separate and composed of galvanized iron 20 in. × 25 in. with three of the sides turned up 1 in. The front side is left flat to facilitate cleaning. The cage thus sits in this bottom and can be readily lifted off when cleaned. This process, which should be attended to at least once in two weeks, can be accomplished without handling the rats or without danger of their leaving the compartments to which they belong. This is done by placing the whole cage on a broad table, lifting the top about one half an inch and carrying it along to the bare table. The rats are thus forced along with the cage and the bottom left free. The old sawdust and excelsior used for bedding are now scraped out and a fresh supply added. The cage containing the rats in

their proper compartments is now replaced in the same manner that it was removed.

Clean fresh water is constantly supplied by means of an inverted bottle (*B*) provided with an air-tight rubber stopper (*R*) and glass tube 5 mm. in diameter (*G*). The spring clips (*C*) permit ready removal of the bottles for filling. The bottles are supported at the lower end on two bent wire nails (*S*) between which the glass tube passes (Figs. 1 and 3). We have found bottles containing eight ounces the most serviceable, as they are not too large and do not need refilling very often.

The albino rat is omnivorous in its diet and will devour almost anything a man will eat. They should be fed once each day. The food consists of cracked corn daily, such table scraps as are available, green stuff, such as lettuce, cabbage, etc. Where a large number of rats are being reared it is advisable to procure the refuse from a restaurant or hotel. Table scraps give a fairly balanced diet and

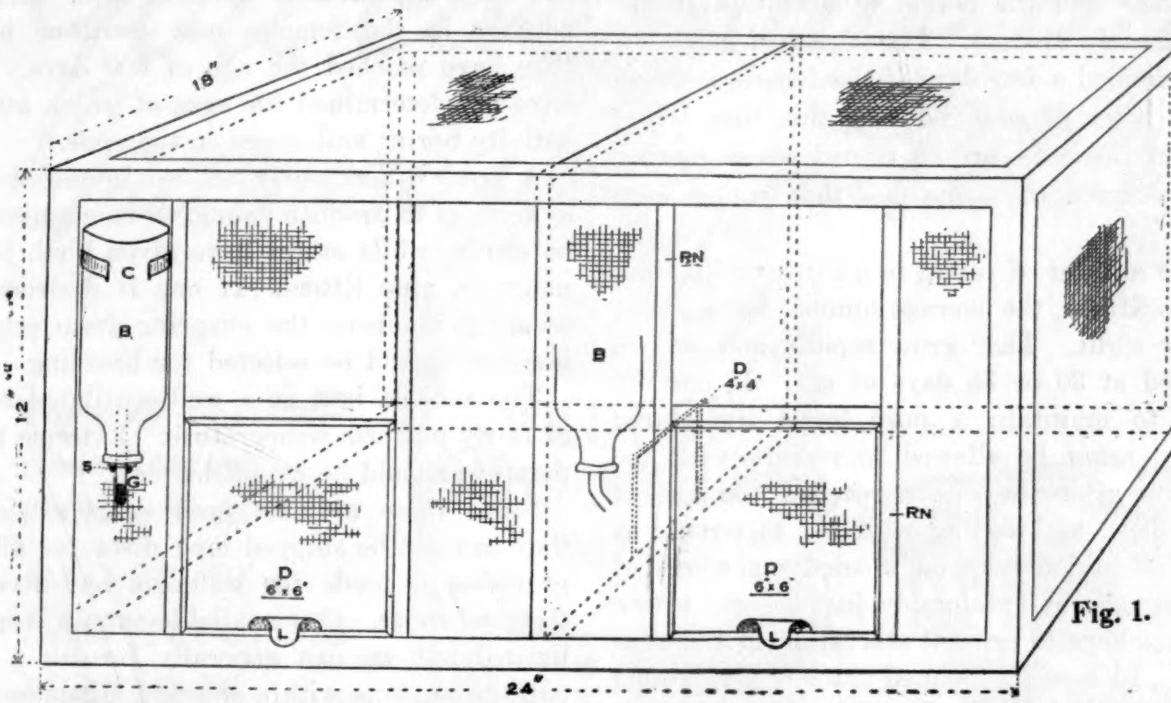

Fig. 1.

FIG. 1. Perspective drawing of the woven-wire portion of the cage showing the dimensions and plan of construction.

B, drinking bottle; *C*, spring clips for holding bottle; *Cg*, cage; *D* 4 in. × 4 in., sliding door in partition dividing the two compartments; *D* 6 in. × 6 in., sliding doors into cages; *G*, glass drinking tube from water bottle; *L*, lifts for sliding doors; *R*, rubber stopper; *Rn*, galvanized-iron runs for sliding doors; *S*, supports for bottle.

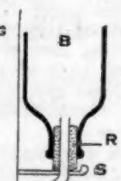

Fig. 3.

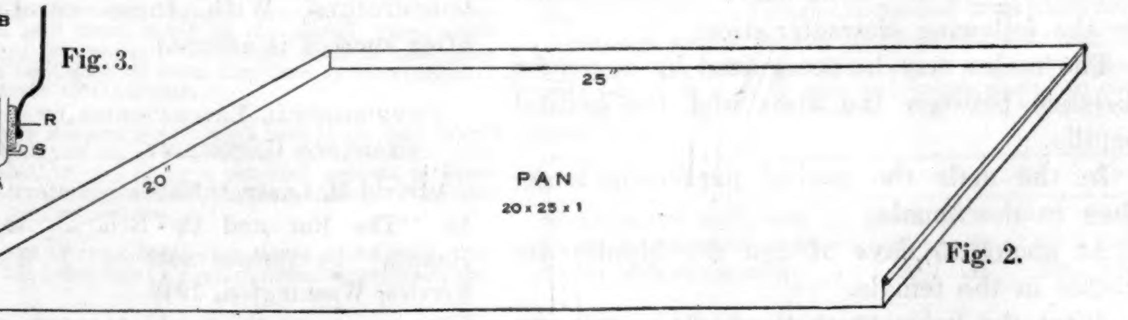

Fig. 2.

FIG. 2. Galvanized iron bottom, giving dimensions and plan of construction.

FIG. 3. Sectional view of drinking fountain showing the support of the bottle, *S*, and the manner in which the tube leads into the cage.

we have had excellent success with this food. If table scraps are not available, cooked beans. nuts and meat two or three times per week should be provided. The amount of food given should always be greater than will be consumed if one is desirous of quick returns. When rats are fed on a sufficient quantity of a well-balanced ration they are very prolific and grow rapidly.

A pair should be placed in each compartment. The female comes in heat about every five days and the period of gestation is approximately 21 days. The period of gestation is prolonged a few days if the female is nursing a litter of young during this time. Numerous instances are on record where mating has occurred the same day that young were born.

The number of young in a litter varies from one to fifteen, the average number being about six or eight. They grow rapidly and can be weaned at 30 or 35 days of age. If one desires to maintain a pure breed the young should never be allowed to remain with the parents after they have reached the age of fifty days, as breeding is likely to occur. A litter should always be weaned regardless of age as soon as (preferably just before) a new litter is born to prevent starvation of the newborn. In case the weaned litter is very young (25 to 35 days) milk should be added to their diet. To prevent inbreeding the sexes should be separated at weaning and confined in separate cages. With proper food, however, inbreeding can go on without apparent detriment for a number of generations.

The sexes in the young may be distinguished by the following characteristics:

The males may be recognized by a greater distance between the anus and the genital papilla.

In the male the genital papilla is larger than in the female.

At about 15 days of age the nipples are visible in the female.

After the hair covers the body a strip extending from the anus to the genital papilla remains almost bare in the female, while in the male this region is covered with hair except a small area immediately below the anus which later becomes the scrotum.

After the descent of the testes into the scrotum the males can readily be distinguished.

The age at which the young females become sexually mature varies between rather wide limits, but usually between 70 and 90 days. The earliest age at which we have found them sexually mature is 69 days. Lantz[1] records a case of sexual maturity at the early age of 35 days and Jackson[2] one at 49 days. Sexual activity in the females may continue until they have reached the age of 600 days. We have not determined the ages at which sexual activity begins and ceases in the male.

A great difference is noticed in the ability of females to produce young. Some appear to be sterile, while others have given birth to as many as nine litters. If one is desirous of securing numbers, the offspring from prolific breeders should be selected for breeding.

The rats do best in a well-ventilated room of fairly uniform temperature. Extreme temperature should be avoided.

Since these animals need daily attention they can not be shipped long distances unless provision is made for watering and feeding them en route. Our available supply is quite limited but we can generally furnish a few pairs to any one within shipping distance who is willing and able to breed rats for purposes of supplying the government, or for general scientific research.

The three main items for success are cleanliness, a sufficient quantity of a balanced ration, and avoidance of great changes in temperature. With these carefully looked after success is assured.

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1 David E. Lantz, "Natural History of the Rat," In "The Rat and its Relation to the Public Health," by various authors. P. H. and M. H. Service, Washington, 1910.

2 C. M. Jackson, "On the Recognition of Sex through External Characters in the Young Rat," *Biological Bulletin*, Vol. XXIII., No. 3, August, 1912.